Annual Report, 2003, NRA00-OES-03, Validation studies for data products from the earth observing system Aqua (PM) platform.

Proposal No. AQUA-0015-0017

Title: Validation of humidity, temperature and ozone measurements of the AIRS instrument over Mauna Loa Observatory, Hawaii.

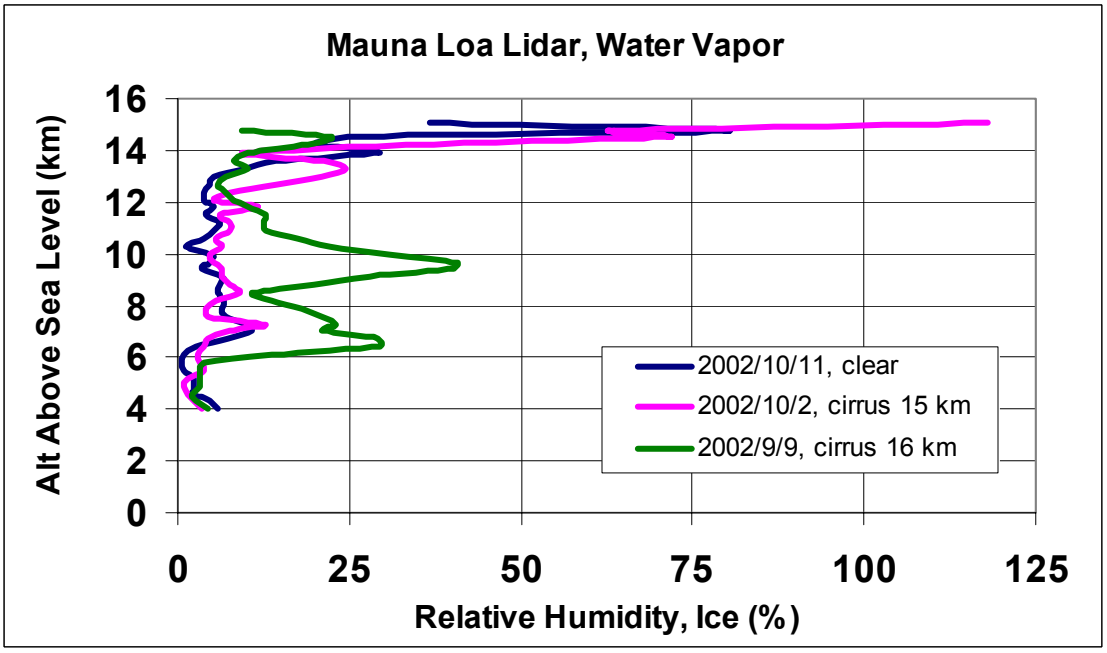
Principal Investigator: John E. Barnes

Mauna Loa Observatory
NOAA/Climate Monitoring and Diagnostics Laboratory
P. O. Box 275
Hilo, Hawaii 96721-0275

E-mail: John.E.Barnes@noaa.gov

Telephone: 808-933-6965 Fax: 808-933-6967

Co-Investigator: Sam Oltmans,
NOAA/Climate Monitoring and Diagnostics Laboratory
325 Broadway
Boulder, CO 80303
Email: Samuel.J.Oltmans@noaa.gov Phone: (303) 497-6676 FAX: (303) 497-5590



Three examples of water vapor observations. Integration time was 2 hours. Cirrus clouds were measured with lidar aerosol backscatter channels at 532 and 1064 nm.

Summary of validation activities.

As part of the proposal, there were some modifications made to the water vapor channels of the lidar. A larger mirror was installed to increase the signal strength and a new detector assembly was installed. The changes improved the performance as expected. No further changes are planned for the system.

Humidity validation: Measurements were made through the troposphere during nighttime overpasses of the satellite by raman water vapor lidar, and with daytime launches of radiosondes. The lidar operated for one hour before and after the overpass. Data files were saved every 5.6 minutes. A few of these files are enough for a reliable humidity measurement in the middle troposphere, but the full two hours of data are needed for upper tropospheric humidity. The two hours of data can also indicate the variability of the conditions at the time of the overpass. Aerosol backscatter was also measured during these overpasses at two wavelengths, 532 nm and 1064 nm. The aerosol backscatter, especially at 1064 nm, can easily detect the presence of subvisible cirrus, and can be used to get an approximate optical depth.

All radiosondes used the Humidicap sensors on Vaisala packages . Five frost-point hygrometer flights were proposed strictly for calibration of the lidar and not for AIRS validation. Two of these flights were made from the observatory with excellent results. The flights clearly showed the altitude (temperature) where the regular radiosonde humidity sensors became inaccurate. The altitude was approximately 11 km which corresponds to a temperature of about -50 C. It was decided that regular radiosonde humidity sensors provided a large enough altitude range and were accurate enough for adequate calibration of the lidar. So the three remaining frost-point flights were used for AIRS validation.

	Proposed	Actual
Water Vapor		
Raman Lidar	14	17
Radiosonde	7	7
Frost-Point	5 for lidar calibration	2 for lidar calibration 3 for AIRS Validation
Temperature		
CMDL Radiosonde	7	7
Ozone		
Ozonesonde	7	7

NOAA/CMDL/Mauna Loa Observatory Validation of AIRS for First Year

Temperature validation: the daytime sondes measured profiles through the troposphere and lower stratosphere (30 km) during overpasses. The lidar provided nighttime profiles from about 35 to 65 km.

Note: the National Weather Service releases daily radiosondes from Hilo at 2:00 AM and PM local time which measure accurate temperature profiles. These coincide with AQUA overpasses and are readily available.

Ozone validation: the seven ozonesonde flights during the daytime overpasses measured the ozone profile. Total column ozone, measured by Dobson photospectrometer, is measured every week day at the observatory and is available for validation.

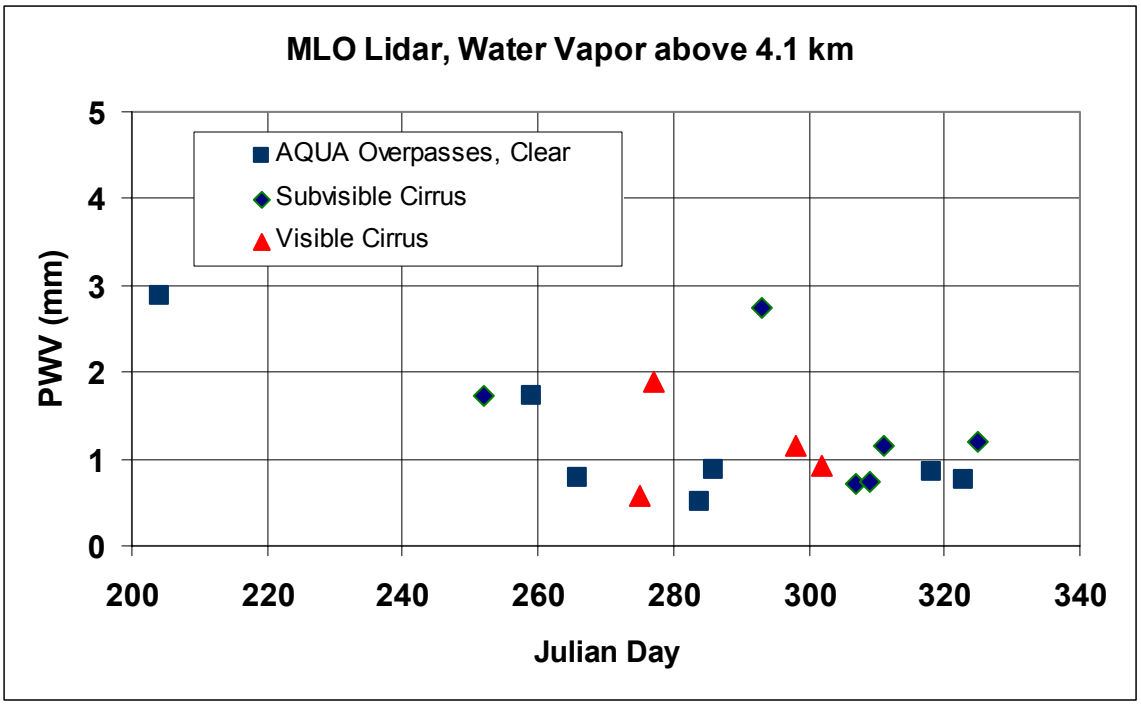
Data Analysis

Cloud conditions at the time of nighttime overpass for lidar observations are tabled below. The aerosol backscatter channels of the lidar have been used to divide the observations into the three categories. Subvisible cirrus correspond roughly to a visible wavelength optical depth of less than 0.03.

Cloud Conditions	Number of Lidar Observations
Clear	7
Subvisible Cirrus	6
Visible Cirrus	4

The subvisible and visible cirrus observations of water vapor and aerosol backscatter, along with the AIRS data, may offer an opportunity for a study of cloud properties.

The conditions above Mauna Loa Observatory are usually quite dry. Since the observatory is at an altitude of 3.4 km above sea level, it is usually above the boundary layer. The plot below is a summary of the precipitable water vapor (PWV) for the overpass dates. The PWV has been summed from 4.1 km to the highest altitude obtained with the lidar (usually between 11 and 16 km).



Archive status

All lidar water vapor observations have been archived in the JPL database. The data are in the NCDF format and are generated by IDL (Interactive Data Language) software. Each observation/overpass is in a separate file. A simple viewer, written in the IDL language, is also archived. Text format files of the observations are also available upon request.

The archiving of the ozonesonde and frost-point hygrometer data is being handled by Holger Voemel, NOAA/Climate Monitoring and Diagnostics Laboratory.

Plans for the coming year

The same number of observations were proposed for the second year. The timing of these observations can be chosen to most benefit the validation activities. There is some flexibility in choosing the cloud conditions (eg. Clear, thin cirrus, low stratus layer), especially with the lidar. The launching of the frost-point hygrometer is more restricted since it is launched from Hilo, at sea level, were rain sometimes prevents the launch. No further changes in the instrument are planned.